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(54) Abstract Title
Flowmeter logging

(57) In a flowmeter, a logging capability is integrated which allows simultaneous logging of pressure and flow. Incorporated in the device are a current generator 4, a receiving circuit 5, and a calculating circuit 6, which normally form part of a flowmeter associated with electromagnetic coils 7 and a measuring probe electrodes 8. Also associated with the device is a pressure transducer 12. Signals from the transducer 12 are applied to a receiving and formatting circuit 13, and then to the store 2. In addition, the formatted data from circuit 13 are compared with similarly formatted data from the flowmeter in a circuit 14 under the control of microprocessor 3, so as to identify and analyse the occurrence of anomalous flow conditions. It has been found that logging at two different resolutions can enable detailed analysis of flow conditions without requiring excessive memory usage. Flow may be logged in a plurality of registers corresponding to different tariffs.

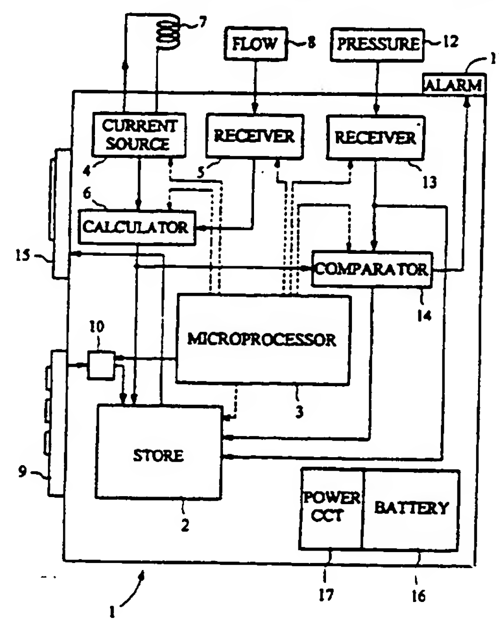

Fig. 1

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

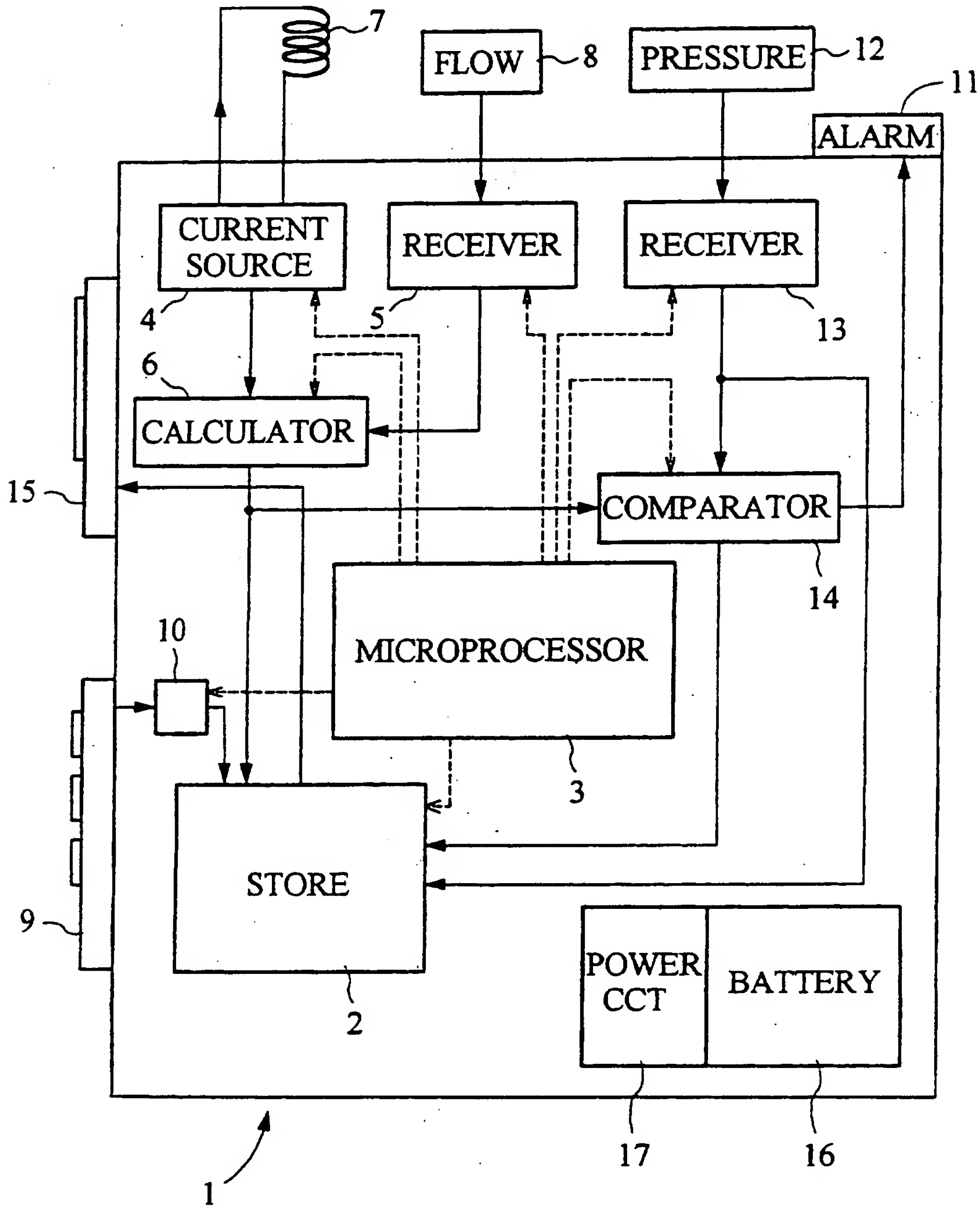
7
FLOW
8
PRESSURE
12
11
ALARM
CURRENT SOURCE
RECEIVER
RECEIVER
4
5
13
6
CALCULATOR
15
COMPARATOR
14
10
MICROPROCESSOR
3
STORE
9
2
POWER CCT
BATTERY
17
16
1

Fig. 1

Flowmeter logging

The invention relates to logging of data from flowmeters and pressure sensors.

Conventionally, for example in the distribution of water, where it is desirable to monitor flow rates and fluid pressure, signals from an electromagnetic flowmeter, for example as a pulse train, and signals from a pressure sensor have been supplied to a data logging device. Such data logging devices are capable of storing the information signals applied thereto for later transmission over data links (either wireless or cabled) to data processing stations. The data logging devices may, however, have some on-board processing capabilities, at least sufficient to enable an engineer operating in the field to be sure that meaningful data are being collected, and they may also have the capability to detect an alarm condition, for example if the wires to the flow meter have been damaged (deliberately or otherwise).

Recently, the inventor has proposed to take advantage of the considerable storage and flexible downloading capabilities afforded by data logging devices by supplying them with additional information, to increase the capacity for monitoring exceptional events, such as an empty pipe, or flowmeter electrode contamination or calibration status, or to enable flow to be billed at a variety of tariffs.

The inventor has realised however that the mere "bolting on" of additional transducers and associated circuitry to the data logging device is not the most efficient approach, and has found that surprising advantages can be achieved if the flowmeter is integrated with the data logging device. In particular, if intelligent data communication is provided between the data logging device and the flowmeter or, more preferably, control of the flowmeter effected by a controller incorporated in the data logging means, additional features may he provided, with simpler architecture, enabling the flowmeter to perform multiple functions.

According to a first aspect of the invention, there is provided a data logging device comprising means arranged to receive inputs from sensing elements of a flowmeter associated with a

pipeline to derive therefrom a signal indicative of flow rate in the pipeline, means for receiving an input representative of pressure within the pipeline, means for storing measures of flow rate and pressure at controlled intervals, and means for storing additional information based on signals from at least one of the flowmeter sensing elements and the pressure sensor.

Preferably at least 3 months of data is stored at a first time resolution, preferably at intervals of approximately 5 minutes or more, preferably at intervals of approximately 1 hour or less, most preferably at approximately 3 to 6 samples an hour, ideally at intervals of approximately 15 minutes.

Preferably, high resolution data is stored at intervals of about 5 minutes or less, preferably at intervals of about 1 minute.

Preferably, data is stored for at least 12 hours, more preferably for at least 24 hours, still more preferably for at least about 1 week, ideally for about 2 weeks.

As a result of long term analysis of flows under a variety of conditions, it has been found that for almost all flows, the most useful analysis information may be provided by a combination of:-

(1) providing regular logging at intervals of approximately 15 minutes (10 to 20 minutes or 3 to 6 samples per hour)) for a prolonged period of time, at least about 1 month, ideally at least about 3 months, as this enables changes in conditions to be spotted reliably, without consuming excessive memory; and

(2) providing more detailed logging at intervals of about 1 minute (intervals of up to about 2 minutes or at most 5 minutes down to about 30 seconds or possible even shorter) for a shorter period of time, ideally at least 24 hours, more preferably at least 1 week, as this allows more detailed analysis of short term fluctuations.

Surprisingly, this provision of a dual store can lead to a remarkable improvement in the utility of data available without requiring excessive memory or data transfer as compared to simply logging at a single fixed interval.

Preferably each quantity stored is averaged over the timing interval before storing. For example, high resolution data stored at 1 minute intervals may be obtained by averaging (or integrating) over several samples during that interval, rather than simply taking the instantaneous value at the sampling time.

The data is most preferably stored as integers in units based on the fundamental measured units (rather than floating point quantities obtained after conversion to desired units and calibration). This may enable more compact storage and may avoid problems if, for example, units are changed during logging.

Preferably, the data is stored in memory in such a way that new data overwrites the oldest data when the memory is full; this may be achieved by using a circular memory, so that the pointer to the next available location automatically wraps around to the first physical storage location on reaching the last physical storage location.

The invention extends to corresponding methods of operation.

Typically the additional information includes indications of one or more of the following parameters:
an empty pipe; a fault in the flowmeter or pressure sensor; contamination of electrodes in the probe of the flowmeter or the pressure transducer; or the occurrence of a flow rate within a predetermined range.

From another aspect, the invention provides a flow data logging device comprising means arranged to receive inputs from sensing elements of a flowmeter associated with a pipeline to derive a flow rate therefrom, means for receiving an input representative of pressure within the pipeline, means for storing measures of flow rate and pressure at controlled intervals, the logging device having means for storing measures of fluid consumption in one of a plurality of different registers selected according to a predetermined condition.

This facility enables different tariffs to be used, according to conditions such as the instantaneous flow rate and the time of day.

In order that the invention may be clearly understood and readily carried into effect, one embodiment thereof will now be described by way of example only, with reference to the accompanying drawing, the single figure of which shows in schematic block diagrammatic form a data logging device exemplifying the invention.

Referring now to the drawing, a data logging device is shown generally at 1. It contains, inter alia, a high capacity digital store 2 and a microprocessor 3 which controls various functions and operations of the device 1, particularly with regard to their timing.

Incorporated within the device 1 are certain components, namely a current generator 4, a receiving circuit 5 and a calculating circuit 6 which normally form part of a flowmeter associated with electromagnetic coils 7 and a measuring probe electrodes 8. The coils 7 and probe electrodes 8 are intended to be mounted in a pipeline through which a fluid to be monitored is flowing, and the electrodes 8 are intended to sense a voltage induced in the medium in response to a magnetic field generated by the coils 7.

The coils 7 are supplied with electrical current from the generator 4, and an indication of the current so supplied is fed to the calculating circuit 6, which also receives, from the receiving circuit 5 which is coupled to the electrodes 8, an indication of the voltage sensed by the probe. These two indications are utilised by the calculating circuit as inputs to an algorithm by means of which there is generated signals indicative of the rate of flow of the fluid through the pipeline. These signals, converted if necessary into digital format, are supplied to the store 2, together with timing information provided by the microprocessor and identification data which may be automatically generated by the microprocessor 3, and/or manually input through a keypad 9 coupled to the store 2, under control of the microprocessor 3, by way of an input controller and formatter circuit 10.

Thus the device as described thus far is capable of obtaining and logging data concerning the flow rate of fluid through the pipeline, and moreover the storage and microprocessing capabilities of the device enable the data to be grouped and/or reorganised so as to correlate fluid flows at certain times, and/or periods when certain rates of fluid flow occur.

The device is also capable, either automatically, under microprocessor control, or manually in response to instructions entered via the keypad 9, of performing self-testing and self-calibration, the results of which can indicate whether the coils and the probe are functioning properly. These results are in any event logged under microprocessor control in the store 2, but if they indicate an immediate problem a local warning can be instantaneously fed to a warning device 11 (a light or buzzer, for example) on the device itself so as to alert the engineer.

Also associated with the device 1 is a pressure transducer 12 arranged to sense the pressure in the pipeline. Signals from the transducer 12 are applied to a receiving and formatting circuit 13 in the device 1, and thence to the store 2. In addition, however, the formatted data from the circuit 13 are compared with the similarly formatted data from the flowmeter in a circuit 14 which is programmed to perform certain correlations on the two sets of data applied thereto, under the control of the microprocessor 3, so as to identify the occurrence of anomalous or other noteworthy conditions that could indicate a malfunction of the coils 7, probe 8 or transducer 12 and/or the lack of fluid in the pipeline, for example.

Certain information from the store may be displayed, under instructions entered via the keypad 9, on a local display device 1 5, for example a liquid crystal display, on the logging device 1. This permits the engineer to view certain parameters substantially on line, and to make direct adjustments or instruct special tests or calibrations to be carried out in the light of the displayed information.

Power for the various components in the logging device 1 may be derived from the mains electrical supply if convenient, or else from a battery 16 located within, or external to, the device 1. The battery 16 may be assisted or replaced by power generated by a circuit 17 from

the current flowing in the flowmeter's detection circuit, as described in GB-A-2 332 527. Furthermore, if high accuracy is required of the flowmeter readings, it may be desirable to correct the flowmeter output signals for non-linearity in the relationship between the input current to the coils 17 and the magnetic field generated thereby, as described in GB-A-2 332 526.

In any event, the integration of flowmeter components into the data logging device as herein described permits of significant improvement in the flexibility of operation and the range of functions achievable, as compared with treating the flowmeter as merely one of several peripheral inputs to a data logger.

The data logger is preferably mounted in a housing adapted for mounting on a flowmeter assembly comprising field generating coils and a pipeline; for example, the housing may include means for securing the housing to a pipeline. The pressure sensor may be mounted within the housing, or may be remotely mounted on the pipeline.

An example of a preferred implementation of logging in a typical meter now follows. The following description includes many advantageous features, each of which may be provided independently of other features of the meter or the logging protocol, unless otherwise stated.

As described above, flow is measured using an inductive method, and pressure is derived from an external pressure transducer based, usually, but not necessarily, on a strain gauge system. The flow measurement is available to the user in various units (e.g. litres/second, cubic metres/day etc), depending on application and the size of the flow sensor (millimetres to metres), and the pressure reading is also available in various units (such as bar or psi) including some for depth of water (feet, metres etc). The pressure measurement is affected by the vertical displacement of the pressure transducer relative to the pressure being measured, and a correction is preferably included for this, which is preferably applied locally to the display, but not to the logged data. As a result of these factors the range of data which might be logged in engineering units is extremely wide. However, by logging the fundamental (calibrated) measurement rather

than its engineering interpretation, a useful saving in storage space and transmission time is achieved, the central data collection system can then translate easily into any desired units. Storing the fundamental measurement, before conversion, is a preferred feature which may be provided independently.

Logger Operation

In a particularly preferred implementation, there are three data loggers, two two-channel flow and pressure loggers and a totaliser logger. The first of these average flow (and pressure) data over a short interval (typically 15 minutes) and store this in large circular buffers for later retrieval. The second stores daily totals in a circular buffer for subsequent examination. Although a similar end result could in principle be achieved by integration of the data logged in one of the flow and pressure loggers, a separate record allows a greater precision and simpler recovery of this data, especially when the system is used for tariff based operation, and this preferred feature (of storing daily totals) may be provided independently.

In addition to the three data loggers there is also an information data base which can also be downloaded: this does not contain any live data, but contains all the static information (serial numbers, calibration information etc) which normally only requires occasional access. Although it is not a data logger, retrieval and control of its contents is very similar.

Flow And Pressure Loggers

In the preferred implementation, there are two Flow and Pressure data loggers which, as the name suggests, log flow and pressure data, and these operate independently of each other. The flow-meter measuring system takes readings of the flow in the sensor at regular intervals, and the data logger averages this information over the logging interval (or sample period). In a preferred implementation which allows for the number of flow acquisition samples in a logging period not necessarily being well defined (or being a dynamic value), the logger operates by adding each measured value to an internal total and when the logging interval expires, dividing the total by the number of samples to obtain the average, which is then stored as a logger record.

The pressure signal (if any) is averaged and logged in an identical fashion, although, in a preferred application, the number of measurement samples averaged for each record may well be different to that for the flow as a result of the system operating parameters.

Each record in the data logger therefore normally consists of two items of data, a flow rate and a pressure. If these were stored in engineering units a floating point (4 byte) value would be required for both values, and some mechanism for adjusting for, or preventing, any change of engineering units part way through a data log would also be required. However, the range of pressures and flow rates are normally relatively limited in absolute terms, and can be represented by integers, thus saving on storage space; this is a preferred implementation. As presently defined, a signed integer is used to store flow velocity, and an unsigned integer stores pressure in millibar, halving the memory requirements and permitting the local display units to be altered if so required without consequence. The data retrieval system is provided with the necessary information (e.g. pipe size) to enable the measurements to be re-generated in any desired units. As the range of data values stored may not be suitable for future applications (for example the resolution of the flow data logger is ± 1mm/sec), a mechanism to support alternative data formats may be provided.

<u>Operation</u>

<u>Data Storage</u>

The data logger consists of a large circular buffer or array, each element of which consists of two 16 bit data values: the exact interpretation of each data value depends on the logger mode for each element: the common or default setting is for the flow logger to store data in the range 0 to +/- 32767 mm/sec, and pressure as 0 to 65535 mbar absolute (or gauge +1000). At the start of each logging interval a counter and a floating point value are set to zero, and each valid data value produced by the acquisition system is added to the relevant floating point value, and the counter incremented. At the end of the sample interval, when a logger data element is to be stored, the floating point value is divided by the counter value to produce an average for the interval, which is then stored as an integer in the logger record. The number of samples averaged in this way is not necessarily the same for flow and pressure, for example in continuous mode flow is measured 3 times per second, but pressure only once per second.

Preferably, the data logger stores at least 3 months data at 15 minutes intervals - this amounts to 8928 data points or just under 35 kilobytes of memory. The logger is preferably set up as a circular memory, such that the latest data record overwrites the oldest record once the logger memory is full.

Control Block

A control block is used to maintain information about the data logger contents. The control block contains timestamps and record serial numbers (RSNs) of the first available record and the most recently stored record, together with necessary internal information (such as buffer addresses, date and time logger was initialised, logging interval etc). The control block is preferably stored in the same physical RAM memory as the data logger buffer, on the basis that if the control block is valid after a restart, then the data contents are also likely to be valid. To provide this certainty the control block is protected by a CRC, and is duplicated should a power failure occur whilst it is being written to.

Timestamps

Each record is allocated a timestamp, which is the time at which the record was stored, as determined by the internal clock. In a preferred implementation, the only timestamp stored is that for the most recent record since all others can be calculated from this. This timestamp is therefore part of the control block.

Preferably, two copies of the time the logger was initialised are also stored. One of these values remains constant, the other is modified by all real time clock corrections: the difference for example can be used to determine overall clock drift.

Record Serial Number

The Record Serial Number (RSN) is used to provide a sequential identity for each record, regardless of time-stamping information. In a preferred implementation, this value is unique (to each logger). This is value is "attached" to the most recent record by storing it as part of the control block, and therefore could be lost (with the data) in a power failure. Consequently the last "used" value of record serial number is stored in non-volatile memory (EEPROM): this is incremented and the incremented value used for the record about to be logged. Each data logger has a separate RSN.

Initialisation

Preferably, data logger records are provided on a "sample boundary", which requires that, for example, 15 minute sample intervals occur on the hour, half hour and quarter hour. Data averaging also lasts for one logging interval, so that the first logger record will occur between one and two logging intervals after the reset point.

Totaliser Logger

Preferably, there are three operational totalisers (forward, net and reverse), along with four (net) totalisers used for tariff based operations. The totalisers integrate flow on a continuous basis, and replace electromechanical registers previously used for this duty. The totalisers may be read at any time via the display system or remotely. Each totaliser is a long word or integer but is constrained to roll back to zero following ±999,999,999. Totaliser values are logged every 24 hours, and whenever the operational units are changed, since the totalisers are not recalculated when this occurs.

Data Storage

The logger preferably comprises a circular buffer or array which contains 366 records. Each record consists of 40 bytes containing 7 totals, units for the two totaliser systems, timestamp RSN, and CRC for the block. Total storage thus amounts to approximately 14.3kbyte. When the buffer becomes full the oldest data block is overwritten by the most recent.

The totalisers are ideally logged routinely at midnight, and whenever the totaliser or tariff units setting is altered (in which case the units logged are those prior to the change)

~~Control Block~~

Since all records are individually tagged with timestamps and RSNs it is not necessary to maintain a separate protected pointer block; this is advantageous.

Timestamps

Each record is individually time-stamped with the time that it was stored, since records may be occasionally be stored arbitrarily.

Record Serial Number

The Record Serial Number (RSN) is used to provide a (preferably) unique (to each logger) sequential identity for each record, regardless of time-stamping information, and is stored as part

of the record. As it could be lost (with the data) in a power failure, the last "used" value of record serial number is stored in non-volatile memory (EEPROM): this is incremented and the incremented value used for the record about to be logged. Each data logger has a separate RSN.

Initialisation

Preferably, the totaliser logger is arranged, after reset, to validate its memory contents , and then continue to append records as required. No mechanism is therefore required or provided to perform initialisation on demand.

Device Information Block

The device information block is not a data logger as such, but is accessed for download in a very similar fashion. It resembles a data logger header section with no downloadable data segment. Its sole purpose is to provide a repository for the non-functional information about the flow-meter, such as serial numbers of the system elements, calibration certificates, dates, and site information such as location.

Data Retrieval

The data loggers may be accessed and controlled by a set of commands. The following section describes a preferred format of the downloaded data for each logger type, along with a description of the commands and controls valid for each logger. The command message set will be described in more detail in later sections.

Depending on system requirements, data retrieval would normally consist of up to two steps:

-Download The Header For The Desired Logger

This enables the contents, ID and validity of the logger to be determined, as required. This operation is not a pre-requisite for data retrieval and may be omitted.

-Download The Logger Data

The command allows for specified data ranges or the entire logger contents to be downloaded, as required.

Compatibility

The basic system described above is deliberately designed to be modified and for additions and extensions to be added in the future. To minimise the impact of these on pre-existing schemes a number of compatibility rules are listed which should allow upgrades to be implemented without problems; each of these is a preferred feature which may be independently provided.

1. Information within the Device Information Block or logger header should not be altered in meaning or format, but may be extended by the addition of new items. The header byte count is provided partly for this reason: the receiving system should allow for the possibility of additional header data items after those it "knows" about, and use the byte count to locate the end of the header/ beginning of data.

2. No command may be changed in such a way as to alter any member of its data field so that the use of the command will produce different results to a previous version.

3. Bytes may be added to any command up to the maximum number of data bytes.

4. Where a command with different operation is necessary a new command will be defined.

5. The data logger stores data in a form defined by the logger format enumerations. The receiving software should check these format settings to determine compatibility: conversely a format enumeration once defined may not be altered in meaning.

6. Where the above rules cannot be met, then the version number of the relevant section must be altered, for example if the size of the status flags in the DIB is altered then the DIB format version must change

Claims

1. A data logging device comprising means arranged to receive inputs from sensing elements of a flowmeter associated with a pipeline to derive therefrom a signal indicative of flow rate in the pipeline, means for receiving an input representative of pressure within the pipeline, and means for storing measures of flow rate and pressure at controlled intervals, the means for storing comprising a first store for storing data at a first time resolution over a first period of time and a second store for storing data at a second, higher, time resolution over a second, shorter, period of time.

2. A device according to Claim 1, further comprising means for storing additional information based on signals from at least one of the flowmeter sensing elements and the pressure sensor.

3. A data logging device comprising means arranged to receive inputs from sensing elements of a flowmeter associated with a pipeline to derive therefrom a signal indicative of flow rate in the pipeline, means for receiving an input representative of pressure within the pipeline, means for storing measures of flow rate and pressure at controlled intervals, and means for storing additional information based on signals from at least one of the flowmeter sensing elements and the pressure sensor.

4. A device according to Claim 3 comprising a first store for storing data at a first time resolution over a first period of time and a second store for storing data at a second, higher time resolution over a second, shorter period of time.

5. A device according to Claim 1, 2 or 4, wherein at least 3 months of data is stored at the first time resolution, preferably at intervals of approximately 5 minutes or more, preferably at intervals of approximately 1 hour or less, most preferably at intervals of approximately 15 minutes.

6. A device according to Claim 1, 2, 4 or 5, wherein the second resolution data is stored at intervals of about 5 minutes or less, preferably at intervals of about 1 minute, preferably for at least 12 hours, more preferably for at least 24 hours, still more preferably for at least about 1 week.

7. A device according to Claims 5 and 6, wherein the first store is arranged to store at least one month of data at intervals of 10 minutes or greater and wherein the second store is arranged to store at least one day of data is stored at intervals of 5 minutes or shorter.

8. A device according to any of Claims 1, 2, 4, 5, 6 or 7, wherein the first resolution is at least 5 times, preferably at least 10 times the resolution of the second resolution.

9. A device according to claim 2 or 3 or any claim dependent thereon, wherein said additional information includes correlated information derived from both said flowmeter and said means for receiving an input representative of pressure.

10. A device according to claim 2 or 3 or any claim dependent thereon, wherein said additional information is derived from a self-test operation.

11. A device according to claim 2 or 3 or any claim dependent thereon, wherein said additional information is derived from a calibratory operation.

12. A device according to any preceding claim wherein said logging device includes a digital store and a microprocessor and means for operating said store under the control of said microprocessor.

13. A device according to claim 12 including entry means permitting the entry of data and/or instructions into said device under the control of said microprocessor and a display means for selectively displaying at least some of the data held in said store in response to instructions entered by way of said entry means.

14. A device according to any preceding claim including an alarm means capable of indicating the occurrence of an anomalous situation.

15. A flow data logging device comprising means arranged to receive inputs from sensing elements of a flowmeter associated with a pipeline to derive a flow rate therefrom, means for receiving an input representative of pressure within the pipeline, means for storing measures of flow rate and pressure at controlled intervals, the logging device having means for storing measures of fluid consumption in one of a plurality of different registers selected according to a predetermined condition.

16. A device according to Claim 15, wherein the predetermined condition is a function of instantaneous flow rate.

17. A device according to Claim 15, wherein the predetermined condition is a function of time.

18. A device according to any of Claims 15 to 17 including means for outputting data from each of the plurality of registers via a data link.

19. A device according to any of Claims 15 to 18 including means for providing a visual output of the contents of each register.

20. A device according to any preceding claim mounted within a housing, the housing being adapted for mounting on a flowmeter assembly including field-generating coils and a pipeline.

21. A device according to any preceding claim and substantially as herein described.

22. A method of operating a flowmeter comprising logging flow and pressure data in a first store at a first time resolution for a first period of time and logging flow and pressure data in a second store at a second, higher, time resolution for a second, shorter, period of time.

23. A method according to Claim 22, wherein the first time resolution is 1 sample every 10 minutes or greater and the first period of time is at least 1 month.

24. A method according to Claim 22 or 23, wherein the second time resolution is 1 sample every 2 minutes or less and the second time period is at least 1 day.

25. A method according to Claim 22, 23 or 24, wherein the second time resolution is at least about 5 times more precise than the first time resolution.

26. A method according to any of Claims 22 to 25, wherein the data is stored as integers.

27. A method according to Claim 26, further comprising converting the stored data for display or output.

28. A method according to any of Claims 22 to 27, further comprising storing daily flow totals.

29. A method substantially as herein described, with reference to the accompanying drawings.

Application No: GB 9923926.1
Claims searched: 1-29

Examiner: Iwan Thomas
Date of search: 26 January 2000

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.R): G1N NAAJB, NAAJD, NAHK, NAJA, NAHAX

Int Cl (Ed.7): G01D 4/00, 4/02, 21/02, G01F 1/58, 1/60, 25/00

Other: Online: WPI, EPODOC, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A	GB 2236396A	(SPECTRASCAN) See abstract, page 1, and claims.	1, 3, 15 & 22
X	GB 2150721A	(ITT) See abstract, and especially col. 1 lines 38-47.	1-3, 15 & 22
X	WO 95/07522A1	(ROSEMOUNT) See page 3 line 30 - page 4 line 2, page 13 claim 3, page 14 claim 6	1, 3, 15 & 22
X	US 5078009	(LEFEBVRE) See abstract.	1, 3, 15 & 22
X	US 4326411	(HALLIBURTON) See abstract, col. 2 line 26-58, col. 4 line 8-26, col. 5 line 34-68.	1, 3, 15 & 22
X	US 4253156	(LISLE) See abstract, col. 1 line 41-col. 2 line 14, and col. 2 line 60-64.	1-3, 15 & 22

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
		E	Patent document published on or after, but with priority date earlier than, the filing date of this application.
&	Member of the same patent family		